CE

2.5 ANCC Contact Hours

The Epidemiology of Methicillin-Resistant *Staphylococcus aureus* in Orthopaedics

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In the specialty of orthopaedics, methicillin-resistant *Staphylococcus aureus* (MRSA) is a major contributor to infections of the soft tissues, surgical sites, and joints, in addition to increasing disability, mortality, and healthcare costs. Inappropriate prescribing and misuse of antibiotics have led to bacterial resistance and the rapid emergence of MRSA. It is imperative for healthcare providers and facilities to improve quality, promote safety, and decrease costs related to MRSA infections. The healthcare profession and society as a whole play an important role in minimizing the transmission of pathogens, reducing the incidence of MRSA infections, and decreasing the development of future antibiotic resistant pathogens. This article discusses the epidemiology of MRSA and describes evidence-based guidelines pertaining to the prevention, minimization, and treatment of MRSA-related infections. Specific application to orthopaedics are discussed in the context of patient risk factors, perioperative and postoperative prophylaxis, and current trends regarding education and reporting strategies.

Staphylococcus aureus bacteria are commonly found on the skin and in the nares of healthy individuals and is also one of the most common pathogenic bacteria associated with infections of the skin and soft tissue. The misuse of antibiotics has led to bacterial resistance, and the rapid emergence of methicillin-resistant *S. aureus* (MRSA). The emergence of MRSA has created significant healthcare challenges in community and hospital settings. In the specialty of orthopaedics, MRSA is a major contributor to surgical site infections, disability, increasing mortality, and rising healthcare costs. To improve the quality of care and decrease healthcare spending, it is important for healthcare providers to be aware of the potential for the development of MRSA infections, in addition to evidence-based practices related to the prevention, minimization, and treatment of MRSA infections. The purpose of this article was to describe the development, presentation, prevention, and treatment of MRSA.

Background and Description

Staphylococcus was discovered in 1880 in the United Kingdom by surgeon Sir Alexander Ogston from purulence that resulted from a surgical abscess within the joint of a knee (Ogston, 1984). In 1884, a German physician and microbiologist named Friedrich Julius Rosenbach appended *Staphylococcus* to *S. aureus* (Todar, 2008). *S. aureus* is an anaerobic gram-positive coccal bacterium that colonizes in the nasal passages and is routinely found on the skin as normal flora, in the oral cavity and gastrointestinal tract (Todar, 2008). It is estimated that up to 20% of individuals are long-term carriers of *S. aureus,* which is the most common class of *Staphylococcus* that leads to *Staphylococcus* infections (Kluytmans, van Belkum, & Verbrugh, 1997). *S. aureus* can cause a wide range of illnesses from minor skin infections to life-threatening conditions such as pneumonia and sepsis. It is also a common cause of hospital-acquired infections (HAIs) and surgical site infections (SSIs).

Penicillin is the antibiotic of choice to treat infections caused by *S. aureus*. When penicillin was first introduced in 1943, antibiotic resistance to *S. aureus* was uncommon. Forty percent of HAIs were *S. aureus* resistant by 1950 with 80% being resistant by 1960 (Chambers, 2001). Penicillin resistance has become extremely common, which has led to the use of penicillinase-resistant β-lactam antibiotics as first-line therapy to treat infections caused by *S. aureus*. The increased use of β-lactam antibiotics has now led to the emergence of MRSA. The increased incidence of MRSA can be contributed to the overuse and inappropriate prescribing of β-lactam class of antibiotics, which includes penicillin derivative antibiotics and cephalosporins. Methicillin-resistant *S. aureus* bacteria are commonly resistant to multiple antibiotics. This antibiotic resistance makes MRSA infections more challenging to treat with standard antibiotics and potentially more life threatening. Methicillin-resistant *S. aureus* has become problematic for hospitals and facilities that have community-type living environments, patients with open

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wounds or implanted devices, and immunocompromised individuals.

Pathogenesis and Description

Bacteria are continually present on the skin surface and are considered part of the normal skin flora. Twenty percent of the population is considered to be colonized with *S. aureus* and 1% of the population is considered to be colonized with MRSA.[3,6] The nose and skin are common areas for MRSA colonization. Colonization means that bacteria are present but it does not cause an infection unless it is able to penetrate the skin's surface. An infection can develop when the skin's surface is disrupted and the bacteria have an easy mode of entry in the body.

The Centers for Disease Control and Prevention (CDC) has listed MRSA as one of the 18 multidrug-resistant microbes, also known as a "superbug" (CDC, 2014a). Methicillin-resistant *S. aureus* infections are categorized as either community acquired (CA-MRSA) or healthcare acquired (HA-MRSA) with CA-MRSA being more common. A large percentage of CA-MRSA begins as a localized skin infection that is due to a break in the skin's surface among healthy individuals, who have not been hospitalized or have not had a recent medical procedure. The majority of HA-MRSA infections can occur as the result of a break in the skins surface, because of factors such as a surgical incision or the insertion of medical devices. Although CA-MRSA and HA-MRSA are defined differently, their mode of transmission is still the same: direct contact with colonized skin or the surface of a shared item where MRSA is present.

CA-MRSA

According to the CDC (2005), there are several factors that determine the classification of CA-MRSA. A person must be diagnosed in an outpatient setting or have a positive culture within 48 hours of a hospital admission. The individual must not have a permanently implanted medical device or an indwelling catheter, in addition to a negative medical history for MRSA. Also, to be considered CA-MRSA, there must not be a recent hospitalization or stay in a long-term care facility.

It is not uncommon for individuals to be colonized with CA-MRSA and remain symptomatic. Approximately 80% of CA-MRSA cases present as uncomplicated skin and soft tissue infections (SSTIs) in the form of cellulitis, folliculitis, impetigo, or an abscess. A CA-MRSA SSTI may require incision and drainage for effective treatment and management, in addition to antibiotic therapy. Rare, but serious complications of CA-MRSA SSTIs, include bone and joint infections, necrotizing fasciitis, or endocarditis (Raygada & Levine, 2009). An example of CA-MRSA that can lead to an orthopaedic-related infection is olecranon or patellar bursitis.

HA-MRSA

Healthcare-acquired MRSA infections also fall under the broad category of HAIs that are infections that are acquired from a healthcare facility such as a hospital or long-term care facility. In a healthcare setting, HA-MRSA is frequently attributed to devices that are used in procedures and can lead to pneumonia, surgical site infections, sepsis, or even death. Common types of HAIs include central line-associated bloodstream infections, catheter-associated urinary tract infections, surgical site infections, and ventilator-associated pneumonia (CDC, 2014b). According to a large sample of acute care hospitals in the United States, 722,000 HAIs were reported in 2011, of which 75,000 patients died during the hospitalization, and more than half of the HAIs were located outside the intensive care unit (CDC, 2014c). An example of an orthopaedic-related HA-MRSA infection would be a postoperative surgical site infection.

MRSA in Orthopaedics

Antibiotic-resistant pathogens such as MRSA can be very challenging for healthcare providers and devastating on a patient's musculoskeletal system. The most common diagnoses associated with MRSA infections in the specialty of orthopaedics include cellulitis, abscess, postoperative surgical site infection, infections resulting from a surgically implanted device, or osteomyelitis. The most frequently conducted surgical procedures due to MRSA infections are incision and drainage of skin and subcutaneous infection, debridement, and bone excision.

Disease Progression and Transmission

There are many factors that contribute to the progression and transmission of MRSA within community and healthcare-related settings with contaminated hands, poor hygiene, and unsanitary environments being the most common. Other contributory factors include antibiotic resistance and various host factors. These contributory factors address many aspects such appropriate prescribing of antibiotics among providers, misuse of antibiotics by patients, evidence-based hand hygiene practices among clinicians, and sanitary hygiene actions among the general public, in addition to environmental and host-related influences. Other points that may be applicable to MRSA progression and transmission are also discussed in prevention and prophylaxis section of this article. Table 1 provides an overview of influencing factors related to MRSA progression and transmission.

Hand Hygiene

Methicillin-resistant *S. aureus* is spread by touching the skin of a contaminated individual or touching a contaminated surface; therefore, proper hand hygiene plays a major role in the prevention and transmission of MRSA. It is particularly important to wash hands in between encounters with individuals who are suspected to have a skin infection, before eating and after using the bathroom. Hands may also be cleansed with a 60% alcohol-based sanitizer (Harris, 2014). In healthcare settings, standard precautions include hand washing and

Table 1. Influencing Factors of MRSA Progression and Transmission

Hand hygiene
Antibiotic resistance
Inappropriate prescribing
Misuse of antibiotics
Environmental sanitation measures
Host risk factors

Note. MRSA = methicillin-resistant *Staphylococcus aureus*.

the use of personal protective equipment such as gloves to address the transmission of pathogens such MRSA.

Antibiotic Resistance

Antibiotic resistance contributes to a significant burden on the healthcare system from economic, quality, and safety standpoints. Research has proven that antibiotics are prescribed unnecessarily and misused by patients 50% of the time (CDC, 2014a). The main factors that contribute to antibiotic resistance are inappropriate prescribing of antibiotics by healthcare providers and misuse of antibiotics by patients. In the United States, up to as many as two million people develop life-threatening infections each year caused by bacteria that have resistant properties related to one or more antibiotics formulated to treat infections and up to 23,000 deaths are directly related to antibiotic resistant infections (CDC, 2014a). It has been estimated that antibiotic resistance is responsible for as many as 20 billion dollars in healthcare-related costs yearly, with costs related to lost productivity being close to 35 billion dollars each year (Roberts, Hota, & Ahmad, 2009).

Inappropriate Prescribing

This is described as the prescribing of antibiotics for viral or self-limiting bacterial infections that lead to acute infections of the respiratory tract (Colgan & Powers, 2001). Several factors contribute to the practice of inappropriate antibiotic prescribing among healthcare providers. These contributing factors include lack of awareness or utilization of evidence-based guidelines that address appropriate antibiotic prescribing, pressure or influence from patients to prescribe an antibiotic, and perceived lack of time for patient education regarding appropriate antibiotic prescribing (Froh, 2013). According to Havers et al. (2014), continuing education efforts to further educate clinicians on appropriate antibiotic prescribing are necessary when it comes to improve the quality of healthcare.

Misuse of Antibiotics

The misuse of antibiotics among the public also plays a role in the development of antibiotic resistance and the increasing incidence of MRSA. Common examples of behaviors that contribute to the misuse of antibiotics include not completing the full course of antibiotics are prescribed, taking leftover antibiotic prescriptions, and cultural beliefs pertaining to antibiotic use.

Environmental Sanitation Measures

Environments that lack proper sanitation cleaning techniques have an increased incidence of spreading MRSA. Examples of environments that are more likely to experience the spread of MRSA due to ineffective sanitation are schools, gymnasiums, nursing homes, or hospitals. These places should disinfect surfaces with antimicrobial cleaning agent to help reduce and eliminate the presence of MRSA. Other measures that thwart the spread of MRSA include regular washing of personal linens in hot water and laundry detergent, showering with antibacterial soap after each athletic event, and avoidance of sharing personal hygiene items such as razors, brushes, combs, or makeup (CDC, 2014a). Healthcare facilities are required by law to follow certain guidelines regarding environmental infection control measures pertaining to disinfection and sterilization (CDC, 2014a).

Host Risk Factors

Individuals can possess certain host risk factors that contribute to an increased incidence for developing an MRSA infection. These include a participation in athletic sports, weakened immune system, presence of an open wound, being elderly, and being extremely young. Other host risk factors include being a chronic MRSA carrier or having other comorbid conditions such as diabetes and obesity. If these risk factors are present and are coupled with a hospitalization, surgical procedure, or nursing home stay or other communal living environments, the risk is even greater for developing an MRSA infection (Klevens et al., 2006).

Clinical Symptoms and Diagnostics

The clinical symptoms that are consistent with an MRSA infection include redness, swelling, and tenderness of an area that resembles a pimple, a rash that is painful and pus-filled, or a lesion with drainage that resembles a spider bite. An individual may also have fever, chills, or shortness of breath. In the practice of orthopaedics, symptoms may include a warm, red, swollen, or painful joint. The presence of MRSA can be confirmed by obtaining a culture of the suspected area. In orthopaedics, a culture may be obtained by doing a skin swab, by joint aspiration, or during a surgical procedure. Results of bacterial cultures are usually available within 48–72 hours. The results provide a culture and sensitivity report, which includes identification of the actual bacteria present and a list of antibiotics that the bacteria are resistant and sensitive to. Other diagnostic studies such as blood culture tests and radiological imaging studies may be obtained if infections of the bone, joint, or lung are suspected.

Treatment and Management

Treatment of MRSA infections is done with antibiotics that are known not to have resistance against MRSA bacteria. According to evidence-based guidelines, the most commonly recommended oral antibiotics to treat MRSA infections are trimethoprim-sulfamethoxazole,

clindamycin, minocycline, or doxycycline, with common intravenous antibiotics being vancomycin, linezolid, or daptomycin. MRSA is frequently treated with two or more antibiotics simultaneously (Harris, 2014). Treatment is also guided by the culture and sensitivity report, in addition to the results of other diagnostic tests. Depending upon the seriousness of the MRSA infection, these antibiotics may be given by mouth or intravenously, and treatment may take place at home on an outpatient basis or in the hospital on an inpatient basis. Within healthcare facilities, strict guidelines regarding isolation precautions are followed to control and prevent the spread of MRSA from infected patients to uninfected patients (CDC, 2014a).

Treatment of MRSA infections in the specialty of orthopaedics may range from antibiotic therapy to specific modalities such as wound management techniques or surgical procedures. Infections of a joint replacement prosthesis can have devastating outcomes for patients, providers, and hospitals, in addition to significant economic burdens. A joint replacement prosthesis infection requires at least 6 weeks of intravenous antibiotic therapy and, in some cases, multiple surgical procedures may be required to clear the MRSA infection and address the damage caused by the bacteria (Osman et al., 2013).

Prevention and Prophylaxis

The first line of defense regarding the prevention and prophylaxis of MRSA-related infections is the consistent practice of evidence-based hand hygiene such as rubbing the hands together with warm soap and water for at least 10 to 15 seconds, drying hands with a single-use paper towel, and using another towel to turn off the sink faucet (Harris, 2014; Mayo Clinic, 2010). Evidence-based hand hygiene also includes the use of alcohol-based hand sanitizers to disinfect the hands with the utilization of soap and water is not an option (Harris, 2014). Prevention and prophylaxis also include healthcare providers following evidence-based guidelines pertaining to appropriate antibiotic prescribing, healthcare workers adhering to universal precautions and isolation precautions, patient education to curb the misuse of antibiotics, and the utilization of recommended environmental sanitation practices to promote disinfecting (CDC, 2014a). A comprehensive MRSA-specific program that includes evidence-based practice guidelines, risk assessment, monitoring and tracking, and preventive education strategies might prove beneficial in minimizing the development and spread of MRSA (CDC, 2014a).

Recent guidelines created collaboratively among the Society for Healthcare Epidemiology of America, Infectious Diseases Society of America, American Hospital Association, Association for Professionals in Infection Control, and Epidemiology and The Joint Commission (TJC) aim to combat MRSA in hospital settings. These guidelines were recently published in *Infection Control and Hospital Epidemiology* and aim to reduce the prevalence of MRSA and prioritize the current MRSA prevention strategies within hospitals (Calfee et al., 2014). The new guidelines include strategies such as MRSA risk assessments, programs that monitor and track MRSA rates, compliance programs pertaining to recommended hand hygiene practices, and MRSA education geared toward healthcare workers, patients, and family members. Many hospitals also use preoperative MRSA screening modalities that include a specific treatment protocol if the patient tests positive for MRSA colonization. Table 2 provides an overview of strategies related to prevention and prophylaxis of MRSA.

Evidence-Based Practice Strategies

Evidence-based practice strategies play an instrumental role in minimizing the spread of MRSA by the development and implementation of strategies that focus on prevention and prophylaxis. Evidence-based practice involves reviewing current literature for actions and applications that have shown to improve the quality of care and patient outcomes and implementing the proven actions and applications into clinical practice. Examples of evidence-based practice modalities to prevent the spread of MRSA include the implementation of clinical practice guidelines (CPGs), the utilization of universal precautions, administration of intravenous antibiotics prior to surgical procedures, and the development of antibiotic stewardship programs (ASPs). The utilization of available toolkits that address infection prevention may serve to encourage best practices that will minimize the development of MRSA (CDC, 2011; Kentucky MRSA Collaborative, 2014). The Institute for Healthcare Improvement 5 Million Lives Campaign's How-to Guide on reducing MRSA contains evidence-based interventions for healthcare facilities to reduce MRSA infections, provides descriptions regarding intervention implementation, and recommends measures that can be used to measure improvement (Institute for Healthcare Improvement, 2014).

Table 2. Strategies Related to the Prevention and Prophylaxis of MRSA

Evidence-based strategies
Surgical care improvement project
Clinical practice guidelines
Universal precautions
Toolkits
Antibiotic stewardship programs
Risk assessments
Measuring quality of clinical practices
Tracking of MRSA data
Reporting of confirmed MRSA cases
Preventive education strategies
Facility education
Patient education
Family and caregiver education
Community education

Note. MRSA = methicillin-resistant *Staphylococcus aureus*.

Surgical Care Improvement Project

A specific example of an evidence-based strategy to prevent the spread of MRSA is the Surgical Care Improvement Project (SCIP). The SCIP is a national partnership of organizations that aim to improve surgical services and minimize surgical complications by reducing the incidence of postoperative surgical site infections (Brendle, 2007). The SCIP consists of core prevention measures that focus on reducing postoperative surgical site infections through antibiotic prophylaxis, in addition to other performance measure recommendations such as postoperative glucose levels, preoperative surgical site hair removal, and maintaining normothermia postoperatively (Green, Mills, Moss, Sposato, & Vignari, 2010).

Clinical Practice Guidelines

According to the Institute of Medicine (2011), CPGs are developed by performing a systematic review of the highest levels of current evidence, in addition to assessing the potential risks and benefits of other alternative modalities. Utilization of surgical site infection prevention CPGs serves to educate and guide healthcare facility staff in the promotion and implementation of infection-prevention measures. Evidence shows that the utilization of evidence-based CPGs that focus on surgical site infection prevention may serve to decrease the incidence and extent of injury caused by surgical site infections (Hall, 2007). The National Association of Orthopaedic Nurses released its surgical site infection prevention CPG in 2013 with the purpose of promoting staff education regarding prevention of orthopaedic surgery-related infections (Smith & Dahlen, 2013).

Universal Precautions

According to the Occupational Safety and Health Administration (2014), the use of universal precautions approach is based on the principle that all human blood and body fluids are infectious and have the ability to transmit infections. Universal precautions consist of standard precautions and transmission-based precautions. Standard precautions include hand washing and the use of personal protective equipment such as gowns, masks, and gloves. Transmission-based precautions are additional measures beyond the standard precautions that address airborne, droplet, and contact mode of pathogen transmission. The development of policies that focus on the core principles of universal precautions are critical when it comes to preventing the spread of MRSA within healthcare facilities.

Antibiotic Stewardship Programs

Hospital-based programs that improve antibiotic utilization by optimally treating infections and reducing antibiotic-related adverse events are referred to as ASPs (Malani et al., 2013). A hospital ASP assists clinicians in improving quality of care and patient safety by increasing the incidence of appropriate antibiotic prescribing for therapeutic and prophylaxis purposes (Kaki et al., 2011). Additional benefits of a hospital ASP include reducing the rate of antibiotic resistance and creating a significant cost-savings for hospitals (Griffith, Postelnick, & Scheetz, 2012). Beginning in 2014, the CDC started recommending that all acute care hospitals execute ASPs (Fridkin, Baggs, & Fagan, 2014).

Risk Assessment Strategies

Screening tools for conducting MRSA risk assessments may prove to be beneficial preoperatively to decrease MRSA-related surgical site infections. A total joint arthroplasty preoperative screening and treatment program for *S. aureus* at one hospital decreased the rate of surgical site infections by 82% (McKee, 2011). Another risk assessment strategy is preoperative MRSA nares screening with treatment prior to orthopaedic surgical procedures such as total knee arthroplasty. A study by Moroski, Woolwine, and Schwarzkopf (2014) revealed preoperative decolonization with nasal mupirocin to be effective in the reduction of MRSA colonization.

Measuring, Tracking, and Reporting Strategies

Measurement, tracking, and reporting strategies that focus on infection-related topics such as incidence, prevention, evidence-based practices, and quality improvement are meant to promote safety of the delivery of healthcare services by minimizing the development of HAIs. Measurement can be used in many ways to determine if outcome data are acceptable or if the clinical quality indicators (CQIs) being used are considered best practice. Measuring performance is also an action required for benchmarking, which may serve to support change that leads to improvement and change. Tracking and public reporting of infection-related data serve to promote the elimination of HAIs (CDC, 2011).

Clinical Quality Indicators

The utilization of CQIs allows for the identification of practices that are in need of improvement (Agency for Healthcare Research and Quality, 2003). Clinical quality indicators can also serve as evidence-based practice guides that can assist with the measurement of the quality and safety of patient care (Smith, Jacobs, Rodier, Taylor, & Taylor-White, 2011). The CQIs that are applicable to infection prophylaxis best practices in orthopaedics include intravenous antibiotic administration, adherence to perioperative skin preparation, systematic assessment of postsurgical incision, proper technique with postsurgical dressing changes, and compliance with facility-specific perioperative and postoperative protocols (Smith et al., 2011).

Data Tracking

The tracking of MRSA in healthcare settings serves to identify problematic areas, measure the progression of preventive strategies, and eradicate healthcare-associated MRSA (CDC, 2014d). Data tracking also provides healthcare facilities with the ability to follow errors related to blood safety, in addition to relevant healthcare process measures such as the rates of adherence to infection control (CDC, 2014d). An example

of an HAI tracking system is the National Healthcare Safety Network, which is the largest HAI tracking system in the nation (CDC, 2014d). The CDC also provides MRSA-specific tracking that includes national estimates and adjusted incidence rates of MRSA infections (CDC, 2014e).

Public Reporting

Consumer demand for the availability of healthcare performance data continues to grow. Many states have passed legislation that mandates facilities to publicly report HAI data. According to the Healthcare Infection Control Practices Advisory Committee (HICPAC), the goals of public reporting of HAI data include quality improvement of healthcare delivery through preventing infections and providing reliable HAI data to consumers, which will support informed choices of healthcare (HICPAC, 2009).

Many guidelines and toolkits exist to assist healthcare facilities with accurate and appropriate reporting of HAI data.

Preventive Education Strategies

Preventive educational strategies that focus on MRSA prevention should involve healthcare staff, patients, family members, caregivers, and the public in general. The healthcare workforce should realize that they play a vital role in MRSA prevention when it comes to HAIs. Healthcare facilities may find the implementation of facility-wide educational hand hygiene programs to be beneficial and supportive when it comes to encouraging a cultural change within the facility. Educational information should be posted throughout the facility for all individuals to view, in addition to posting educational information in each patient room. These preventive education strategies may serve to minimize the development of HA-MRSA.

Preventive educational strategies can involve educating the community about MRSA prevention by providing educational sessions to schools, day care programs, social groups, and civic clubs. Community-based education should focus on the basics of MRSA prevention such as hand-washing, appropriate personal and environmental hygiene, and keeping suspected MRSA wounds covered. These community-based preventive educational strategies may serve to minimize the spread of CA-MRSA.

Current Trends

Vancomycin has always been the standard of care when treating MRSA, in addition to being the least expensive antibiotic available to treat MRSA. A recent survey administered to infectious disease specialists revealed that there is an elevated concern of increasing minimum inhibitory concentrations with vancomycin use for MRSA isolated in hospitals (Decision Resources Group, 2014). This survey also revealed that over the last 2 years, almost two-thirds of the infectious disease specialists reported prescribing higher doses of vancomycin to achieve increasing trough levels, in addition to elevated minimum inhibitory concentrations being the most common reason for prescribing branded medications, such as daptomycin (Cubicin), linezolid (Zyvox), and ceftaroline (Teflaro). According to Rossi et al. (2014), the first case of a new superbug that is considered a part of the MRSA classification and is also resistant to vancomycin has been identified in Brazil. These factors reveal the potential for MRSA to develop into a serious public health epidemic.

The use of an interdisciplinary team approach when developing and implementing MRSA-prevention strategies is gaining popularity in healthcare facilities. An interdisciplinary team approach encourages a more dynamic, comprehensive, and collaborative that is advantageous for patients, healthcare professionals, and healthcare facilities (Grant & Finocchio, 1995). Evidence-based teamwork systems that involve all disciplines serve to maximize the use of best practices, people, and resources to attain the most desirable outcomes for patients (Agency for Healthcare Research and Quality, 2014).

Another current trend to combat the development of MRSA-related infections involves multifaceted strategies to minimize stress and burnout among healthcare professionals. Wellness programs and appropriate staffing ratios are two examples of strategies aimed at preventing stress and burnout among providers. Cimiotti, Aiken, Sloane, & Wu (2012) investigated job-related burnout among registered nurses and if it influences the development of inpatient, HAIs among patients. This study revealed that there was a significant association between burnout among registered nurses and the development of urinary tract infections and surgical site infections among patients.

The CDC (2015) recently released the annual National and State Healthcare-associated Infection (HAI) Progress Report, which contains a summary of data that is submitted to the CDC's National Healthcare Safety Network. The recent report revealed significant declines nationally of certain HAIs during 2013 with the greatest reductions in central line-associated bloodstream infections and SSIs (CDC, 2015). The HAI Progress Report data help measure and track HAI-prevention progress nationally. However, the national 2013 goals set by the *National Action Plan to Prevention Health Care–Associated Infections: Road Map to Elimination* (HAI Action Plan) established by the U.S. Department of Health and Human Services were not met (CDC, 2015). This proves that a multifaceted approach involving healthcare facilities, healthcare providers, and the public in general is needed to further decrease the incidence of HAI infections that compromise patient safety and increase morbidity and mortality rates.

Beginning in January 2015, TJC introduced the Infection Prevention and Healthcare-Associated Infection Portal (TJC, 2015). This portal combines the TJC's online infection-prevention resources into one easily accessible format. Prior to the development of this portal, information pertaining to infection control and HAIs was available separately. The newly developed portal also includes links related to various infection-prevention resources such as infection-prevention CPGs and evidence-based sterilization procedures. The overall goal for developing this portal is to provide easy access for healthcare providers to obtain up-to-date resources pertaining to infection prevention and HAIs (TJC, 2015).

Conclusion

Antibiotic resistance has become an epidemic nationally and internationally and has led to the development of potentially deadly antibiotic-resistant bacteria such as MRSA. To prevent further spread of MRSA, healthcare providers must be knowledgeable of evidence-based antibiotic-prescribing guidelines, teach patients how to use antibiotics appropriately, and practice recommended hand hygiene. Healthcare facilities must implement policies that include protocols consisting of evidence-based infection-prevention CPGs and environmental sanitation practices. The general public plays a role in preventing antibiotic resistance as well by avoiding antibiotic misuse, practicing recommended hand and personal hygiene, and appropriate sanitation of the personal environment. The responsibility to prevent the spread of MRSA lies in both healthcare and society as a whole.

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